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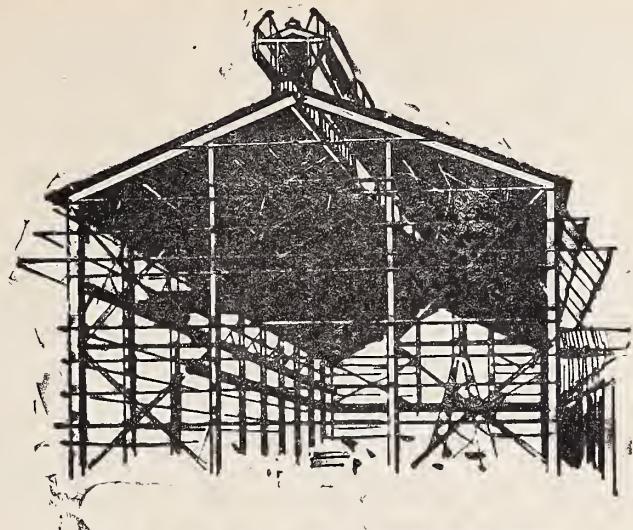
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BRIDGE LOADINGS ROUND THE WORLD

The Indian Roads Congress issued a questionnaire to various countries in the world about the bridge loadings applied for design purposes.

The following countries very kindly sent the replies:

- (1) America (U.S. Bureau of Public Roads)
- (2) Austria
- (3) Belgium—see pp. 128-129
- (4) Canada (Toronto and Ontario)
- (5) Finland
- (6) Germany (Federal Republic)
- (7) Great Britain
- (8) India
- (9) Italy
- (10) Japan
- (11) Malaysia
- (12) New South Wales (Australia)
- (13) New Zealand
- (14) Norway
- (15) Philippines
- (16) Rhodesia
- (17) Sweden
- (18) Switzerland
- (19) Turkey

The ensuing Tables have been prepared from the information received.

The Indian Roads Congress is very grateful to the above mentioned countries for the information supplied.

| QUESTIONS | AMERICA (U.S. Bureau of Public Roads) | AUSTRIA | | | |
|---|---|-------------------|---|-----------------------|------|
| | | Bridge Classes | | See Fig. 6 in Plate I | |
| 1. LOADINGS | Article 1.2.5* | Total weight | tonnes | 25 | 16 |
| (i) Design train loading truck loading or any special loading for each category of roads. | (i) Truck loading and lane loading H10-44, H15-44, H20-44, H15-S12-44, H20-S16-44 and Military loading. (See Figs. 1, 2, 3 & 4 in Plate I). | Fore wheel | tonnes | 4 | 2.5 |
| | For trunk highways or other highways which carry heavy truck traffic, minimum loading H15-S12-44. | Back wheel | tonnes | 8.5 | 5.5 |
| | For Inter-state highway system, Military loading (see Fig. 4 in Plate I) wherever it causes moments or shear greater than those caused by H20-S16 truck or the standard lane loading. | Equivalent weight | tonnes/m ² | 1.67 | 1.07 |
| (ii) Distance between successive trains or loads | (ii) No successive trains or loadings. | | | | |
| (a) | | | | | |
| (b) | | | | | |
| (c) | | | | | |
| (d) | | | | | |
| (e) | | | | | |
| 2. Lateral disposition of train loading or other types of loadings with respect to : | Article 1.2.6* | | | | |
| (a) Kerb | (a) Distance from kerb to centre line of wheel—2 ft (for slab design—1 ft). (see Figs. 1 and 3 in Plate I). | (a) | The standard trucks, 2.5 m wide, are equal to the width of a lane; therefore the trucks have to be put close together, so that the live load for the considered structural part arises to a maximum. It is not necessary to shift the wheels of the trucks to the kerb. | | |
| (b) Central line of the bridge | (b) No particular lateral disposition. | (b) | The caterpillar, as the only load on the roadway, has a maximum deviation of 0.5 m on both sides from the centre line of the roadway. | | |
| 3. No. of train loadings taken for design of each span of bridges and culverts with the following number of traffic lanes : | Articles 1.2.7, 1.2.8, 1.2.9* | | | | |
| (i) Two lanes | (i) 100 per cent of either 2-lane loading or one standard H or H.S. truck per each lane. | | | | |
| (ii) Two lanes each way on a divided highway | (ii) 75 per cent of either 4 lane loading or one standard H or H.S. truck per each lane. | | | | |
| (iii) Three lanes each way on a divided highway | (iii) 75 per cent of either 6 lane loading or one standard H or H.S. truck per each lane. | | | | |
| | <i>Note : In case of a 3-lane bridge, 90 per cent of the full live load.</i> | | | | |
| | | | | | |

*Articles referred to relate to the A.A.S. H.O. Standard Specifications for Highway Bridges (1961).

CANADA

TORONTO

Truck loading is based on the H20-S16-44 or the heavier H25-S20 loading in the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

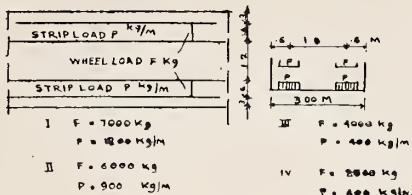
ONTARIO

All H20-S16-44

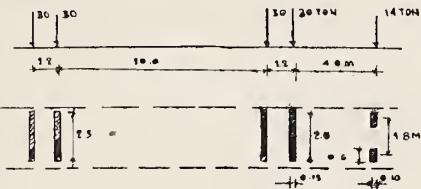
Article 1.2.4 to 1.2.9*

FINLAND

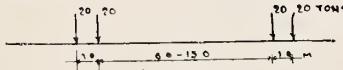
LANE LOAD



HEAVY TRUCK LOAD I



HEAVY TRUCK LOAD II

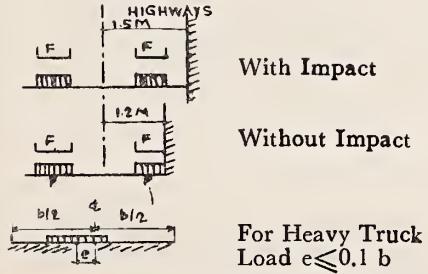


TORONTO

- For trucks, wheel is placed 2 ft away.
- No relationship for trucks.

ONTARIO

Article 1.2.6.*



TORONTO

- 2 train loads.
- (a) 2 train loads.
(b) 3 train loads with 10 per cent reduction.
(c) 4 train loads with 25 per cent reduction whichever gives the most critical stress.
- As in (i) above except that (c) becomes 4 lanes or more with 25 per cent reduction.

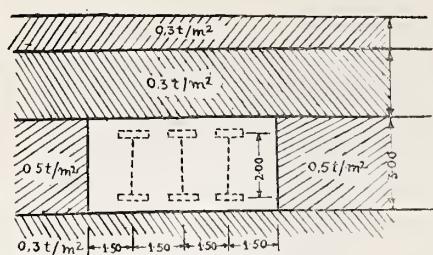
- 100 per cent
- Two lanes 100 per cent, remaining lanes 50 per cent.

ONTARIO

Article 1.2.9*

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

FEDERAL REPUBLIC OF GERMANY



- (i) For Federal Autobahns, Federal Highways and Rural Highways of 1st order, Bridge Class 60 = 6×10 t

For Rural Highways of 2nd order and District Roads, Bridge Class 30 = 6×5 t

For Minor Roads, Bridge Class 16 & 6, see Fig. 7 in Plate II.

- (a) For main carriageway, the load should be so placed as to cause worst effects. Laterally it can be placed upto the kerb.

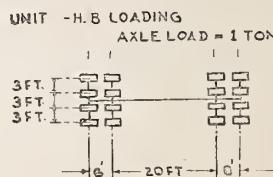
- (b) Outside the carriageway, uniformly distributed load of 0.3 t per m^2 for bridges of class 60 and 30.

- (i) & (ii) The portion of train loading according relieving effect will not be considered.

GREAT BRITAIN

Bridges carrying public roads are designed for HA loading (British Standard 153-Part 3-Section A—see Fig. 8 in Plate II consisting of a uniformiy distributed load plus a single knife edge load. The U.D. load varies with the span but between 20 and 75 ft it is constant at 2200 lb per linear foot of 10 ft wide lane. The knife edge load is placed parallel to the supports of the member under consideration and has a value of 27,000 lb for a 10 ft wide lane.

Bridges carrying important roads are checked for 45 units of HB loading to British Standard 153.



- (a) Any part of the bridge deck between kerbs, including the hard shoulder, if any, is deemed to be subject to HA or HB loading.

- (i) Two lanes of HA loading or one lane of HB loading together with one lane of 1/3 HA loading.

- (ii) Two lanes of HA loading and two lanes of 1/3 HA loading or one lane of HB loading and the adjacent lane with 1/3 HA loading. The two lanes in the other carriageway each with HA loading.

- (iii) Two lanes of HA loading and four lanes of 1/3 HA loading or one lane of HB loading and the two adjacent lanes with 1/3 HA loading. In the other carriageway, two lanes with HA loading and the other lane with 1/3 HA loading.

INDIA

Clauses 201* and 207*

- (i) Class "AA" tracked vehicle and Class "AA" wheeled vehicle.
 - Class "A" train of vehicles.
 - Class "B" train of vehicles.
 - (See Figs. 9, 10 & 11 in Plate III)
 - (a) For every 2-lane width of bridge Class "AA" one tracked or wheeled vehicle or two lanes of Class "A" loading whichever creates worst effects, to be used for road bridges in municipal limits, industrial and other specified areas and on specified highways.
 - (b) Class "A" to be used for all roads on which permanent bridges and culverts are constructed.
 - (c) Class "B" for temporary bridges, etc.
- (ii) See Figs. 9, 10 & 11 in Plate III
- | | |
|----------------------------------|-------------|
| For Class "AA" tracked vehicles— | 300 ft min. |
| For Class "A" train of vehicles— | 65 ft min. |
| For Class "B" train of vehicles— | 65 ft min. |

Clause 207* (See Figs. 9 to 11, Plate III)

- (a) Class "AA" clear distance between kerb and outer edge of wheel or track=1ft for single lane bridge with 12 ft carriageway; 2 ft for multi-lane bridge with less than 18 ft carriageway; 4 ft for 18 ft or above carriageway:
- In case of Class "A"—clear distance 6 in. between kerb and wheel having 20 in. width for all carriageway widths. Class "B" 6 in. for wheel having 15 in. width.
- (b) Not given.

Clauses 113* and 208.2*

- (i) One train of Class "AA" tracked or wheeled vehicles or two lanes of Class "A" train of vehicles for National Highways and State Highways.
- (ii) 80 per cent of two trains of Class "AA" tracked or wheeled vehicles or of four lanes of Class "A" train of vehicles.
- (iii) This type of bridge construction is not permitted.

ITALY

For the purpose of loading, highways are divided into the following two categories.:

- (I) Highways for civil and military use, and
- (II) Highways for civil use only (local and minor roads).

Loading system.

- Type 1. a continuous train of 12 t truck
- „ 2. a single 18 t steam roller
- „ 3. a crowd load of 400 kg per sq. m.
- „ 4. a continuous train of military loads of 61.5 t
- „ 5. a continuous train of military loads of 32 t
- „ 6. a single military load of 74.5 t

(See Fig. 13 in Plate—IV)

Loading system to be adopted in the design of highway bridges.

Category (I)—One military type—the heaviest of types 4, 5 or 6 flanked by one or more trains of truck (Type 1) with crowd loading of 400 kg/m² (Type 3) on the footpaths.

Category (II)—The most unfavourable of the following conditions :

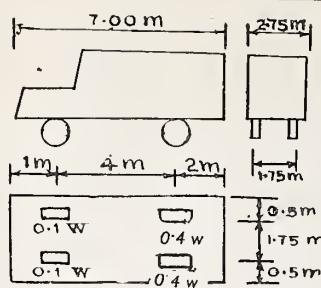
- (a) one or more lanes loaded with continuous trains of trucks (Type 1) with crowd loading on the footpaths (Type 3)
- (b) one or more steam rollers (Type 2) side by side with crowd loading on footpaths (Type 3).

No details given.

No details given.

*Clauses referred to relate to the Indian Roads Congress Standard Specifications & Code of Practice for Road Bridges-Sections I & II (1964).

JAPAN



T-loading for design of floor system :

| Class of bridge | Load | Weight W(t) |
|-----------------|------|-------------|
| 1st | T-20 | 20 |
| 2nd | T-14 | 14 |

One vehicle longitudinally and as many as possible transversely.

Note : For spans exceeding 150 m, specifications are otherwise considered.

Loading for the Design of Main Girders

| Class of bridge | Load | Main-lane loading (width of 5.5 m) | | Other lanes |
|-----------------|------|------------------------------------|---------------------------------|-------------------------------|
| | | Live load P.(kg/m.) | U.D.L. P. (kg./m ²) | |
| | | | 1 ≤ 80m 150 > l > 80m | |
| 1st | L-20 | 5000 | 350 430 - 1 ≥ 300 | $\frac{1}{2}$ of main loading |
| 2nd | L-14 | 70 per cent of L-20 | | |

B.S. 153-Part 3A: 1954
(see Fig. 8 in Plate II.)

Type HA (British) loading represents approximately effect of 3 vehicles, each 22 tons in weight, closely spaced, in each of two carriage-way lanes, followed by 10-ton and 5-ton vehicles. For short span members, the effects of two 9-ton wheels 3 ft apart have been considered (i.e., approximately two $11\frac{1}{4}$ -ton wheels with 25 per cent overstress).

(a) Nil.

(b) Nil.

B.S. 153-Part 3A—1954—Clause 4-A
(a), (b) and (c).

(i) Occupied by full type HA loading.

(ii) Occupied by full type HA loading.

(iii) Two lanes occupied by full type HA loading and one lane occupied by one-third the full lane loading.

NEW SOUTH WALES

Clauses 2.5* and 2.7*

- (i) Truck loading and lane loading H10-44, H15-44, H 20.44 and H15-S12-44 and H20-S16-44.

Minimum loading :

- (a) Metropolitan bridges H20-S16-44.
 (b) Bridges on Main roads and Highways : H20-S16 44.
 (c) Other bridges :

Through roads—H20-S16-44 unless H15-S12-44 is considered desirable.

Other than Through Roads (such as those serving small group of settlers) lower classes of loading, if desirable.

- (ii) No successive trains or loads.

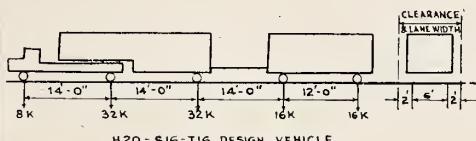
Clause 2.6*

- (a) For deck slab design (concrete, steel grid or timber deck), the distance of the wheel to the kerb face may be only 1 ft (see Figs. 1, 2 and 3 in Plate I).
 (b) No particular lateral disposition.

NEW ZEALAND

Design loading for new bridges for all National Board Roads or Govt. Subsidiary Roads as per A.A.S.H.O.

H20-S16-44 Truck and Lane loading and H20-S16-T16 truck loading, whichever gives the worst effects.



Clause 2.9*

- (i) 100 per cent of 2 lane loading or of one standard H or HS truck per each lane.
 (ii) 75 per cent of 4 lane loading or of one standard H or HS truck per each lane.
 (iii) 75 per cent of 6 lane loading or of one standard H or HS truck per each lane. Where continuous spans are designed, for the truck loading, only one standard H or HS truck per each lane shall be considered on the structure.

Based on A.A.S.H.O. Standard HS Truck Disposition.

See Fig. 3 in Plate I.

- (i) 2 Trucks

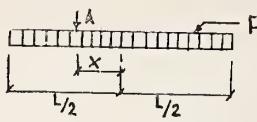
- (ii) 75 per cent of 4 trucks
=3 trucks

- (iii) 75 per cent of 6 trucks
=4.5 trucks

*Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).

NORWAY

Equivalent loading per lane :



$$A = 12 + 8x/L \text{ tons}$$

(Class I & II)

$$\text{Class I : } p = 0.5 + \frac{35}{L+5}$$

$$\text{Class II : } p = 0.35 + \frac{24}{L+7}$$

tonnes per linear metre of lane.
Impact included in A and p.
L=actual loaded length of lane.

Class I and II mainly refer to lane widths for two lane bridges usually used for roadway widths more or less than 6.5 metre respectively.

The above lane loadings are normally considered uniformly distributed over lane widths from 3.0 to 3.75 metre.

Besides, the structure is designed for a local loading of two axles of each 18 t (13 t allowable + 5 t impact) with lateral position shown in the sketch below :

Furthermore, the structure is controlled for one up to 30 metre long metre.

Class II lane load laterally distributed as the above two right wheel loads (or a corresponding other position, if more unfavourable).

(i) The above equivalent loading in each lane.

(ii) -do- -do-

(iii) The full equivalent loading in two lanes, 50 per cent in the third lane.

PHILIPPINES

Class of bridge loading.

AA—H20 or H20-S16 See Figs.
A—H15 or H15-S12 1, 2, 3 in
B—H10 Plate I &
Fig. 14 in Plate IV.

Class "AA" bridges for specially heavy traffic units in locations where the passage of such loads is frequent or located in large cities and industrial centres.

Class "A" bridges for normally heavy traffic units and the occasional passage of specially heavy loads.

Class "B" bridges for light traffic units and the occasional passage of normally heavy loads. Class "B" bridges shall be considered as temporary or semi-temporary structures. There is also loading H-10-35 as given in Fig. 14 in Plate IV.

Similar to A.A.S.H.O. Article 1.2.4.

Figs. 1 and 3 in Plate I.

RHODESIA

HA loading, supplemented with 30 units HB loading allowing 25 per cent increase in permissible working stresses.

See Fig. 8 in Plate II for HA loading. For HB loading, see sketch under Great Britain, p. 98.

All in accordance with B.S. 153/1954-Part 3—Section A.

(a) 18" from kerb line in any analysis not incorporating a lateral distribution analysis.

Accidental loading of a 4 ton wheel is investigated at edge of parapet, allowing 25% increase in permissible working stresses.

(b) Symmetrical, unless a lateral distribution analysis is undertaken.

(i) Full HA loading in each lane.

(ii) As above.

(iii) N/A.

(iv) Three lanes. Full HA loading in two adjacent lanes; 1/3 HA in the third lane.

SWEDEN

See Fig. 15 in Plate IV

(a) Lane loading consisting of one 14 t axle load + distributed "p" t/m, when $p=2.4$ t/m for loaded length less than 10 m, and 1.1 t/m for loaded length over 90 m.

For loaded length between 10 m and 90 m, "p" varies according to formula

$$p = 2.4 - \frac{1.3}{80}(l-10)$$

where l is the loaded length in metres (distance between the zero points of influence curve) or by interrupted loading, the sum of loaded lengths and length of the unloaded parts between.

(b) Single truck loading of 100 t. This single truck loading may be assumed as exceptional loading without concurrent loading stress increased by 15 per cent

On special roads, it can be prescribed that the above mentioned single truck shall be considered as normal traffic loading.

See Fig. 15 in Plate IV.

SWITZERLAND

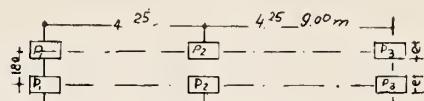
(i) Main roads : Distributed load of 360 kg per m^2 and one axle load of 15 t for each lane.

Secondary roads : The same with 240 kg per m^2 and 10 t.

(ii) Instead of distributed loading with one axle load, all parts should be checked also for the following train load :

3 axle loads for each lane with 1.5 m distance behind each other of 15 t for main roads, 10 t for secondary roads.

TURKEY



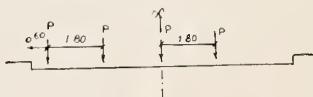
| | P_1 (t) | P_1 (t) | P_3 (t) | e (cm) |
|--|--------------|--------------|--------------|-----------|
|--|--------------|--------------|--------------|-----------|

State Roads
H20-S16 2 8 8 51

Provincial
Roads H15-
S12 1.5 6 6 38

Village Roads
H10 1 4 0 25

The distributed load goes all over the bridge. The train and axle loads in the position which gives the maximum stress.



(i) Two lane loading or single truck loading.

(ii) Each side of the divided highway shall essentially be regarded as belonging to a separate bridge. However, in some cases on long bridges, certain deduction in the loading is often allowed.

(i) Not more as two lanes are loaded with axle or train loads.

(ii) & (iii) Not more as two lanes each way have to be loaded with axle or train loads.

One truck for each lane.

| QUESTIONS | AMERICA (U.S. Bureau of Public Roads) | AUSTRIA | CANADA | | | | | | | | | | | | |
|---|---|--|--|-----|----|----|----|--|----|-------------|----|----|----|-----|--|
| 4. Area of the train of vehicle assumed in elevation for calculating the effective wind pressure. | Article 1.2.14* Wind pressure at the rate of 100 lb per linear ft on moving live load acting at 6 ft above deck. This is to be taken only for group loading combination as explained in Article 1.4.1*. | The Austrian standards adopt a 2.5 m high rectangular traffic area in correspondence with the position of live load. | TORONTO A simplified procedure is used for spans 125 ft and under. 100 lb per linear ft transversely. 40 lb per linear ft longitudinally. Both forces applied simultaneously 6 ft above deck. | | | | | | | | | | | | |
| 5. Impact factor due to live loads assumed for different types of loads on : (i) Concrete bridges | Article 1.2.12* Impact fraction $I = \frac{50}{L+125}$ (maximum impact factor 30 per cent) L=length in ft of the portion of the span which is loaded to produce the maximum stress in the member. This is applicable only for structural members of group (A). | Impact Factor (i) Concrete bridges : L=span of the structural part (metre) <table border="1"> <tr> <td>0</td><td>10</td><td>30</td><td>50</td><td>70</td></tr> </table> Platform girder, direct loaded main girder 1.40 1.30 1.20 1.10 1.00 Indirect loaded main girder 1.40 1.25 1.10 1.00 1.00 Floor slab 1.40 | 0 | 10 | 30 | 50 | 70 | TORONTO (i) Concrete bridges—30 per cent | | | | | | | |
| 0 | 10 | 30 | 50 | 70 | | | | | | | | | | | |
| (ii) Steel bridges . (iii) Prestressed concrete bridges Variation of impact according to span length. | No distinction has been made in impact factor for different types of loads or bridges of different materials. For further explanation, see Article 1.2.12*. | (ii) Steel bridges : <table border="1"> <tr> <td>L in metres</td> <td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>20</td> </tr> </table> Impact factor Lane I 1.64 1.50 1.41 1.35 1.30 1.18 Lane II 1.32 1.25 1.20 1.17 1.15 1.09 <table border="1"> <tr> <td>L in metres</td> <td>40</td><td>60</td><td>80</td><td>100</td> </tr> </table> Impact factor Lane I 1.1 1.07 1.05 1.04 Lane II 1.05 1.03 1.02 1.02 For all following lanes : Impact factor=1 | L in metres | 2 | 4 | 6 | 8 | 10 | 20 | L in metres | 40 | 60 | 80 | 100 | (ii) Steel bridges—30 per cent (iii) Prestressed concrete bridges—30 per cent ONTARIO Article 1.2.12.* |
| L in metres | 2 | 4 | 6 | 8 | 10 | 20 | | | | | | | | | |
| L in metres | 40 | 60 | 80 | 100 | | | | | | | | | | | |

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

| FINLAND | FEDERAL REPUBLIC OF GERMANY | GREAT BRITAIN |
|--|---|---|
| Height 2 m for the length of loading. | <p>For bridges without load—250 kg/m^2</p> <p>For bridges under construction—125 kg/m^2</p> <p>For bridges with load—125 kg/m^2</p> <p>For pedestrian & cycle bridges—75 kg/m^2</p> | A plane with a continuous height of 8 ft above the carriageway for highway bridges or 4 ft above the footway for footbridges. Allowance may be made for the screening effect of the structure on the plane, based on projected areas. |
| | The above loading acting in case of <ul style="list-style-type: none"> (a) road bridges at 2.0 m height (b) pedestrian bridges at 1.8 m height. | |
| $I=40$ per cent when filling $h(m) \geq 3 \text{ m}$ $I=16 (3.0-h)$ per cent for height of fill varying from $0.5-3.0\text{m}$ For timber bridges always $I=20$ per cent. | <p>Impact Factor</p> $\varphi = 1.4 - 0.008 \times l\varphi \geq 1.0$ <p>$l\varphi$=governing length in metres</p> <p>(See D.I.N. 1073, 1074, 1075 and 1078 for the determination of the value of $l\varphi$).</p> | HB loading has no impact factor. HA loading incorporates an impact factor of 25 per cent on the heaviest axle in the train of vehicles from which HA loading is derived. It is constant for all forms of construction. |

INDIA

Clause 212.4*—Also see Figs. 9, 10 and 11 in Plate III.

The lateral wind force against any exposed moving load shall be considered as acting at 5 ft above the roadway and shall be assumed to have the following values :

Highway bridges, ordinary—200 lb per linear ft

Highway bridges carrying tramway—300 lb per linear ft

While calculating the wind pressure on live load, the clear distance between the trailers of a train of vehicles should not be omitted.

Clause 211*

(i) (a) Class "A" or "B" loading—Impact fraction

$$I = \frac{15}{20+L};$$

(b) Class "AA" loading—Impact percentage :

For spans less than 30 ft :
For tracked vehicles—

25 per cent for spans upto 15 ft, linearly reducing to 10 per cent for spans of 30 ft.

For wheeled vehicles—25 per cent.

For spans of 30 ft or more:
Tracked vehicles :

10 per cent upto 130 ft span and according to the curve in Fig. 12 in Plate III for more than 130 ft span.

Wheeled vehicles :

25 per cent for spans upto 40 ft, for more than 40 ft span in accordance with the curve in Fig. 12 in Plate III.

(ii) (a) Class "A" or "B" loading

$$I = \frac{30}{45+L}$$

(b) Class AA loading .

Tracked vehicles—10 per cent for all spans.

Wheeled vehicles—25 per cent for spans upto 75 ft and for over 75 ft spans as per curve in Fig. 12 in Plate III

ITALY

A wind pressure of 250 kg per sq. m. of exposed surface shall be taken as acting on the structure when the bridge is unloaded.

When the structure is loaded, the pressure should be taken as 100 kg per sq. m. acting on the above said surface increased by a continuous strip 3 m. high raising from the roadway.

In order to take into account the dynamic effects for spans upto 100 m, the live loading should be multiplied by the coefficient ϕ

$$\text{where } \phi = 1 + \frac{(100-L)^2}{100(250-L)}$$

L =the span of the bridge between abutments measured in metres. The formula also applies to reinforced concrete beam and slab construction.

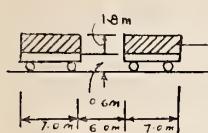
For spans exceeding 100 m, ϕ is assumed to be unity.

*Clauses referred to relate to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges—Sections I and II (1964).

JAPAN

MALAYSIA

Exposed to wind



B.S. 153-Part 3A-1954, Clause
12 (a)-(d)

A plane with a continuous height of 8 ft above the carriageway for highway bridges and 5 ft above the footway for footway loading. Allowance may be made for the screening effect of the structure on the plane based on projected areas.

B.S. 153-Part 3A : 1954

Where type HA loadings are not adopted, the allowance for impact on highway bridges are as follows :

(i) Concrete bridges—

(i) Concrete bridges— 25 per cent

$$i = \frac{7}{20+L} \text{ for main girder}$$

$$i = \frac{20}{50+L} \text{ for floor system.}$$

(L=span in metres)

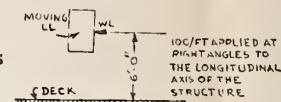
(ii) Steel bridges—

(ii) Steel bridges— 25 per cent

$$i = \frac{20}{50+L}$$

(iii) Prestressed concrete bridges—same as for concrete bridges.

(iii) Prestressed concrete bridges— 25 per cent

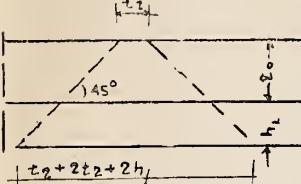
| NEW SOUTH WALES | NEW ZEALAND | NORWAY | PHILIPPINES |
|---|---|---|---|
| <p>Clause 2·15*</p> <p>Lateral wind force at 100 lb per linear ft acting at a height of 6 ft above the deck.</p> <p>Alternatively, 66 lb per linear foot laterally plus 33 lb per linear foot longitudinally acting simultaneously.</p> | <p>Wind loads as per A.A.S.H.O. Specifications for longitudinal elevation.</p> <p>See Fig. 3 in Plate I and sketch in Q. 1, p. 101.</p> | <p>Normally no wind pressure is considered on loaded bridge.</p> <p>On bridge without load, wind pressure is assumed equal to 250 kg per m² of exposed area.</p> |  <p>LOC/FT APPLIED AT RIGHT ANGLES TO THE LONGITUDINAL AXIS OF THE STRUCTURE</p> <p>See Figs. 1,2 and 3 in Plate I.</p> |
| <p>Clause 2·13*</p> <p>(a) Impact=10 per cent for steel or concrete substructure above the foundations but not rigidly connected to the superstructure and structures carrying 1½ to 3 ft of fill.</p> <p>(b) Steel or concrete superstructures and those parts of steel or concrete substructure above the foundations which are rigidly connected to the superstructure as in the rigid frames or continuous designs and structures carrying less than 1½ ft of fill. The impact shall be</p> $I = \frac{50}{L+125} \times 100 \text{ per cent}$ <p>(max. 30 per cent)</p> <p>(min. 10 per cent)</p> | <p>Impact factor not dependent on bridge type. Impact factor in use :</p> $I = \left(\frac{50}{L+125} \right) \times 100 \text{ per cent}$ | <p>Impact is included under Q. 1—equivalent loading.</p> <p>The local loading (Q. 2) assumes 5 t impact for an allowable 13t axle load (38·5 per cent)</p> <p>Allowable gross weights of vehicles are established by comparing their effect with the effect of the class II equivalent loading.</p> <p>By this, the above 38·5 per cent impact is added to the heaviest axle, but it is so far considered unnecessary to add impact to the remaining axles.</p> | <p>For all kinds of bridges,</p> $I = \frac{50}{L+125} \text{ in which}$ <p>$I = \text{impact fraction (maximum 30 per cent)}$</p> <p>$L = \text{length in feet of the portion of the span which is loaded to produce the maximum stress in the member.}$</p> |

*Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).

| RHODESIA | SWEDEN | SWITZERLAND | TURKEY |
|---|---|---|---|
| As under Section 12— B.S. 153/1954—Part 3, Section "A". | The wind pressure area of traffic load shall be supposed to be a rectangle 2 metre higher from the deck and length equal to loaded length. | For road bridges, 3 metre high band is assumed. | Effective wind pressure is calculated as follows : (a) for unloaded bridge : 1·5 times the height of the full area of the bridge deck including the hand-rails. Load 250 kg per m ² . (b) for loaded bridges : height of the area of the bridge deck elevation + 2·0 m for live load. Wind load 125 kg per m ² . |
| (i) & (ii) Concrete and steel bridges—Included in HA loading. See B.S. 153/1954. (iii) For Prestressed concrete bridges : As above, but for dynamic stability the following apply : (a) The vertical acceleration of the superstructure under $\frac{1}{2}$ HA loading, travelling at 40 m.p.h. shall not exceed 0·5 ft per sec ² . (b) The natural frequency of the superstructure under a live load of 100 lb per sq. ft. shall not be less than 3 cycles/sec., where the natural frequency equals | 40 per cent for lane loading and only for the wheel loads, and not for the uniform load p. When wheel is in contact with railing or another limitation (kerb, etc.) of the roadway, no impact allowance has to be considered. No impact for single truck loading. | $\text{Impact} = 5 \times \frac{100+L}{10+L}$ where L is the length of span in m. | $\phi = 1 + \frac{15}{L+37}$ where L=span length in metres. $\phi_{\max.} = 1·3$ |
| $0·75 \sqrt{\frac{EI}{wL^4}}$ cycles/sec. where "E" is Young's Modulus for the superstructure in lb per sq. in., "I" moment of inertia of superstructure (in. ⁴), $w=B \times 100 +$ weight of superstructure in lb/ft run. "B"=breadth of superstructure. "L"=span of superstructure in feet. | | | |

| QUESTIONS | AMERICA (U.S. Bureau of Public Roads) | AUSTRIA | CANADA |
|---|--|---|--|
| 6. Ground Contact Area The shape of contact area for design calculations and formulae adopted for dispersion of the wheel loads through the wearing coat and the slab for designing. | Article 1.2.6 and 1.3.2 (c) As per Figs. 1 and 3 in Plate I. For further details, see Article 1.3.2 (c). | For the shape of the contact area, see Q. 1, Loadings. If there is a load distributing layer, concentrated loads may be dispersed under an angle of 45 degrees. The dispersion may be extended to the centroidal axis of the considered structural part only. | TORONTO Shape is circular for slabs on soil. Otherwise dispersion is in accordance with "Standard Specifications for Highway Bridges" (A.A.S.H.O.—1961). ONTARIO Article 1.3.2* |
| 7. Equivalent UDL or knife edge loading, if adopted for working out : (i) Bending moment. (ii) Shear. | Articles 1.2.7 and 1.2.8* See Fig. 2 in Plate I. | | TORONTO (i) For bending moment 640 lb per linear ft UDL + 18000 lb (in lieu of H20—S16 truck) (ii) For shear 640 lb per linear ft UDL + 26000 lb (in lieu of H20—S16 truck) ONTARIO None |
| 8. The percentage of the live load on the bridge taken for calculating the braking force in the design of substructure of the bridge. | Article 1.2.13* 5 per cent of L.L. without impact in all lanes carrying traffic headed in the same direction acting at 6 ft above deck. The load shall be lane-load plus knife edge load without impact and reduction as per Q. 3 applied. Longitudinal forces due to friction of beams shall also be provided for in the design. | 30 per cent of the weight of the heaviest vehicle (caterpillars excluded). | TORONTO 5 per cent ONTARIO Article 1.2.13* |

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

| FINLAND | FEDERAL REPUBLIC OF GERMANY | GREAT BRITAIN |
|--|---|--|
|  <p>For ground contact area of wheel load, see Fig. 7 in Plate II.</p> | <p>Generally the dispersion of wheel load be taken at 45 degrees. In the case of massive slabs, the dispersion as above will be up to the middle of the slab.</p> | <p>The contact area for a heavy wheel of $1\frac{1}{2}$ tons in the HB loading is taken as 15 in. \times 3 in. with the 3 in. in the direction of travel. This load may be dispersed through the wearing course and slab at an angle of 45 degrees longitudinally and transversely. For structural distribution in a slab, normal structural theory may be used, e.g., Pigeaud or Westergaard.</p> |
| See Q. 1 | See Q. 1. | |
| 20 per cent | 100 per cent | <p>The longitudinal force for HA loading is 10 Tons for spans up to 10 ft, plus 0.5 Ton per foot of span over 10 ft with a maximum of 25 Tons. The longitudinal force for 45 units of HB loading is 45 Tons for all spans.</p> |

QUESTIONS

6. Ground Contact Area

The shape of contact area for design calculations and formulae adopted for dispersion of the wheel loads through the wearing coat and the slab for designing.

A
A
F
F

Clauses 207 and 207·2.*
See Figs. 9, 10 and 11 in Plate III, for shape of contact areas. For one way slab dispersion = effective width measured parallel to the supported edges :

$$e=kx \left(1 - \frac{x}{l} \right) + W \text{ and}$$

$$e=1.2x+W \text{ for cantilever.}$$

Effective dispersed length of slab (in the direction of span) = dimension of tyre contact area in the direction of span + twice the thickness of slab and wearing coat. For two way slabs, dispersion as per rational method.

7. Equivalent UDL or knife edge loading, if adopted for working out :

(i) Bending moment.

(ii) Shear.

8. The percentage of the live load on the bridge taken for calculating the braking force in the design of substructure of the bridge.

Nil

See Table 2 page 131

INDIA

ITALY

In slab calculations, the weight of a rear wheel (6t) of the roller is distributed over a rectangle, one side of which is equal to the sum of the width of the roller wheel plus twice the depth of slab and wearing coat; the other side is equal to 10 cm plus twice the depth of slab and wearing coat.

For the bridge on highway of category I, an additional calculation must be made in respect of the two rear axles, each of 18t, of load in Type 6. In such a case, the total load of the two axles must be distributed over a rectangle with sides of 2.65 × 1.12m each side being increased by twice the depth of slab and wearing coat.

Normally the calculation is carried out for a slab. When the lengths of the sides differ substantially, the slab can be considered as being bound by the longer sides, increasing the rectangular distribution in the direction of those sides by one half of the shorter side.

On main beams

In considering transverse distribution, the loading should be so placed as to give the most unfavourable effects.

In the case of beam and slab construction, if a rigorous calculation is not made based on the theory of slabs, then all the beams should be similar and designed to carry the increased edge stresses.

Clause 214·2*

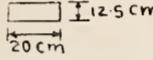
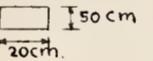
- (a) 20 per cent of the first train load plus 10 per cent of the loads of succeeding trains or part thereof, the train loads in one lane only being considered for this purpose. When only part of the first train is on the full span, the braking force shall be only 20 per cent of portion of load on the span.
- (b) For bridges having more than two lanes : as in (a) above for the first two lanes plus 5 per cent of the loads on the lanes in excess of two. (Effect of impact is not taken into consideration).

Braking force shall be equal to 1/10 of the load superimposed by a continuous train of trucks (Type 1). This force, however, shall not be less than 0·3 of the heaviest axle of the load system being considered.

*Clauses referred to relate to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges— Sections I and II (1964).

*Articles referred to re

JAPAN

| | |
|-------------|---|
| Front Wheel |  |
| Rear Wheel |  |

MALAYSIA

B.S. 153 : Part 3A : 1954
 Appendix A 1(c) and 3(f)
 Contact area of 15 in. \times 3 in.,
 the smaller dimension being in
 the direction of travel.
 Dispersal under the wheel load
 shall be taken at 45 degrees.

For bridges
 with span length
 less than 150 m,
 it is not adopted.
 For longer spans,
 equivalent U.D.L
 may be specified.

B.S. 153 : Part 3A : 1954
 Appendix A.
 See Fig. 8 in Plate II.

10 per cent of T loading.

B.S. 153 : Part 3A : 1954
 Clause 10

Span upto 10 ft = 10 Tons

Span above 10 ft = 10 Tons +
 $\frac{1}{2}$ Ton for each
 ft of span over
 10 ft, but not
 exceeding 25
 Tons.

| NEW SOUTH WALES | NEW ZEALAND | NORWAY | PHILIPPINES |
|--|---|--|---|
| Clause 2·5* | The shape of contact area as per A.A.S.H.O. H20-S16-44 loading. | The contact area for the wheel load given under Q. 2 is 50 cm lateral, by 20 cm in driving direction. | See Figs. 1 and 3 in Plate I and also Article 1.3.2 (c) of A.A.S.H.O. Bridge Specifications (1961) |
| Contact width of each rear tyre equals 1 inch per every 2000 lb of total weight of loaded truck. | Distribution according to the A.A.S.H.O. Specification based on Westergaard method. | For moment calculation, the above area is increased by thickness of wearing coat + 50 per cent of slab thickness in each direction. | |
| Clause 2·5* | As per A.A.S.H.O H20-S16-44 | Sce Q. 2 above. | Similar to A.A.S. H.O. Bridge Specifications (1961). |
| See Fig. 2 in Plate I | Lane Loading. | For shear, the actual knife edge load "A" reaches the max. value of 16 tonnes according to formula $(x = \frac{L}{2})$ | Fig. 2 in Plate I. |
| Clause 2·14* | None in the case of road bridges. | So far braking force of 3 t for lane lengths upto 5 m increasing to 12 t for 25 m length or more has been adopted. At present the question of increasing braking forces is being considered. | 5 per cent of the total lane loading for moment without impact and traffic headed in the same direction subject to reduction in the load intensity as follows : One or two lanes 100 per cent Three lanes 90 per cent Four lanes or more 75 per cent |
| 5 per cent of total live load (without impact) on the bridge loaded to give maximum effect. This shall be taken as acting 6 ft above road level. | | | |

*Clauses referred to relate to Highway Bridge Design Specifications of N. A. of A. S. Road Authorities (1965).

| RHODESIA | SWEDEN | SWITZER-LAND | TURKEY | | | | | | | | | | | | |
|---|---|--------------|---|--|---------------|--------|---------|------|------------|---------|------|-----------|------|------|-----------|
| Elliptical, major axis 21 in., minor 9 in. Pigeaud's general dispersion, i.e., 45 degrees from contact area to main reinforcement in structural member. | Shape of contact area—See Fig. 15 in Plate IV. | — | Main reinforcement perpendicular to traffic : Slab span (S) from 0·6 to 2·0 m $E = 0·6S + 0·76$ Bigger than 2 m $E = 0·4S + 1·14$ Main reinforcement parallel to traffic $E = 0·175S + 0·98$ | | | | | | | | | | | | |
| (i) N/A (ii) N/A | See Fig. 15 in Plate IV. | — | For each lane :  <table border="1"> <thead> <tr> <th></th> <th>(q t/m)</th> <th>$Q(t)$</th> </tr> </thead> <tbody> <tr> <td>H20-S16</td> <td>1.00</td> <td>9.00 13.00</td> </tr> <tr> <td>H15-S12</td> <td>0.75</td> <td>6.75 9.75</td> </tr> <tr> <td>H-10</td> <td>0.50</td> <td>4.50 6.50</td> </tr> </tbody> </table> | | (q t/m) | $Q(t)$ | H20-S16 | 1.00 | 9.00 13.00 | H15-S12 | 0.75 | 6.75 9.75 | H-10 | 0.50 | 4.50 6.50 |
| | (q t/m) | $Q(t)$ | | | | | | | | | | | | | |
| H20-S16 | 1.00 | 9.00 13.00 | | | | | | | | | | | | | |
| H15-S12 | 0.75 | 6.75 9.75 | | | | | | | | | | | | | |
| H-10 | 0.50 | 4.50 6.50 | | | | | | | | | | | | | |
| See para 10 B. S. 153 (1954) Part 3 Section "A". | Irrespective of the clear width of the roadway, the braking force shall be 7 tonnes for 20 m length & 12 tonnes per 30 m length or more uniformly distributed over the clear width of roadway. For intermediate lengths, linear interpolation is applied. | — | 15 per cent of one standard truck for the whole width of the bridge applied on the surface of the deck. | | | | | | | | | | | | |

| QUESTIONS | AMERICA (U.S. Bureau of Public Roads) | AUSTRIA | CANADA |
|--|--|--|--|
| 9. The surcharge effect considered in the design of abutments of the bridge due to the live load on the approach fill. | Article 1.2.19* Surcharge effect on the abutment due to the live load on approach fill = 2 ft. No surcharge, if adequately designed R.C.C. approach slab is provided. | No special standards. | TORONTO Equivalent to an additional 2 ft of backfill. ONTARIO 2 ft surcharge without approach slab. None if approach slab is used. |
| 10. Footpath loading (state) min. width of footpath acceptable. (i) Crowd load assumed per sq. ft. (ii) Any variation in the above load for change in the span length. | Article 1.2.11 (c)* No minimum width of footpath. (i) 85 lb per sq. ft. for slab, stringers and immediate supports. (ii) For girders, trusses, arches, etc. 0–25 ft span —85 lb/sq. ft. 26–100 ft span —60 lb/sq. ft. Over 100 ft span, $P = \left[30 + \frac{3000}{L} \right] \left[\frac{55-W}{50} \right]$ where $P = L.L. \text{ per sq. ft. (max. } 60 \text{ lb per sq. ft.)}$ $L = \text{loaded length of side-walk in feet.}$ $W = \text{width of side-walk in ft}$ (iii) No such loading. | Minimum width = 1.50 m Bridge Class I $= 0.5 \text{ t per m}^2$ Bridge Class II $= 0.4 \text{ t per m}^2$ Nil | TORONTO Normal use-100 lb per sq. ft. Nil ONTARIO Article 1.2.11* |
| (iii) Any special loading specified for the accidental mounting of vehicles on the footpath and in that case overstressing, if any, allowed. | | One truck of 25 tonnes (16 tonnes) placed to produce maximum stress. No overstressing allowed. | Not definite. ONTARIO Article 1.2.11* |

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

| FINLAND | FEDERAL REPUBLIC OF GERMANY | GREAT BRITAIN |
|---|--|--|
| $q = \frac{1}{12}F + \frac{2}{3}P$ q in kg per m ² F in kg P in kg per m | Earth surcharge and earth pressure are determined from the characteristic value of the soil at site. The traffic load considered in the design of bridge should be placed at the unfavourable positions. Individual loads can be substituted by uniformly distributed loading. | The surcharge effect is taken as being equivalent to two feet height of fill. |
| See Q. 1. | | |
| Minimum width = 1.5 m | | 80 lb per sq. ft.; minimum width normally accepted is 6 ft. |
| (i) 400 kg per m ² | (i) 0.5 t per m ² in case of spans less than 10 m | 100 lb per sq. ft. |
| — | (ii) $0.550 - 0.005L \geq 0.4$ t per m ² L = span in metre | These loadings may be reduced in the same proportion as the uniformly distributed load in HA loading, for spans above 75 feet. |
| Discrete wheel load F (See Q. 1) Stressing : Concrete & reinf. 65 per cent Steel \leq Yield point | (iii) | No A four ton wheel load occupying a 12-in. diameter circle. 50 per cent overstress is permitted. |

QUESTIONS

9. The surcharge effect considered in the design of abutments of the bridge due to the live load on the approach fill.

10. Footpath loading (state) min. width of footpath acceptable.

(i) Crowd load assumed per sq. ft.

(ii) Any variation in the above load for change in the span length.

(iii) Any special loading specified for the accidental mounting of vehicles on the footpath and in that case overstressing, if any, allowed.

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Transport-Communications Monthly Review

INDIA

ITALY

Clause 217*

(a) When adequately designed R.C.C. approach slab covering the entire width of roadway, with one end resting on the abutment, and extending for a length of not less than 12 ft into the approach is provided, no live load surcharge need be taken.

(b) Otherwise surcharge load should be taken as per Table 1-p. 130.

Clause 209*

5 ft minimum width.

The peak crowd load

(i) Normal 58 lb per sq. ft.
In case of bridges located near town of pilgrimage or large congregational fairs, 100 lb per sq. ft.

(ii) The main girders, trusses, arches or other members supporting the footways shall be designed for the following live loads per sq. ft. of footway area.

(a) for effective spans of 25 ft or less—85 lb or 100 lb as the case may be :

(b) 26—100 ft spans

$$P = P' - \frac{(L-25)}{3}$$

(c) over 100 ft spans

$$P = \left(P' - 55 + \frac{3000}{L} \right) \left(\frac{55-W}{50} \right)$$

where $P' = 85$ lb/sq. ft. or 100 lb/sq. ft. as the case may be, $P = L.L.$ in lb per sq. ft; $L = E.F.$ span of main girder, truss or arch in ft; $W =$ width of footway in feet.

(iii) 4 Tons (including impact) distributed over a contact area 12 in. in diameter. In that case, working stress to be increased by 25 per cent.

No details given.

Uniformly distributed load including impact effects 500 kg per sq. m.

The above should be checked for the effect of a 5 t including impact wheel load.

If the foot-path is carried on a cantilever slab, then the load can be distributed along the root of the cantilever for a length equal to twice the distance of the centre of the load to the root or a constant moment per metre of root can be applied of :

$$\frac{PL}{L \times 2} = \frac{P}{2} t \text{ per m}$$

At the free ends of the slab, such moment shall be doubled.

*Articles referred to relate

*Clauses referred to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges—Sections I and II (1964).

| JAPAN | MALAYSIA | NEW SOUTH WALES |
|---|--|--|
| It is not specified, but considered as the case may be. | 2 ft surcharge of earth is assumed in abutment design. | Clause 2.19* |
| | | Surcharge effect on the abutment due to the live load approach fill shall be equal to not less than 4 ft of earth. |
| | | No surcharge effect to be taken if adequately designed R.C.C. approach slab is provided. |
| | B.S. 153 : Part 3A; 1954 Clause 4C | Clause 2.12* |
| (i) 500 kg per m ² | (i) 100 lb per sq. ft. upto 75 ft | 5 ft minimum width |
| (ii) No | (ii) Over 75 ft length, the standard uniformly distributed loads given in type HA loading multiplied by a reduction factor of 80/2200. | (i) 80 lb per sq. ft. of footway area for design of footway, stringers and their immediate supports. For metropolitan areas, it should be 100 lb per sq. ft. (ii) Girders, trusses, arches and members of main structure shall be designed for the following L.L. per sq. ft. of footway area : |
| | | Span 0-25 ft - 80 lb ,, 26-100 ft - 60 lb ,, Over 100 ft - 40 lb |
| (iii) No | (iii) A wheel load of 4 Tons, distributed over a contact area of 12 in. in diameter. The working stress shall be increased by 25 per cent to meet this provision. | (iii) An isolated concentrated extra load of 4,000 lb |

* Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).

| NEW ZEALAND | NORWAY | PHILIPPINES |
|--|---|---|
| When highway traffic can come within a distance from the top of the structure equal to one half the height, the pressure shall have added to it a surcharge pressure equal to not less than 2 ft of filling. | Usually a surcharge of 2 t per sq. metre has been considered for abutment design. A differentiation between low and high abutments ought to be introduced. | 2 ft L.L. surcharge to be added to earth pressure. |
| Minimum width 4 ft | For design of footpath structures : 400 kg per m ² | Minimum width—2 ft 6 in. clear. |
| (i) 60 lb per sq. ft. (50 per cent of this when combined with main traffic live loads). | (i) Contemporary footpath loading and local load according to Q. 2 200 kg per m ² footpath. | (i) 85 lb per sq. ft. |
| (ii) No | (ii) Contemporary footpath loading and equivalent loading according to Q. 1 : 0.1 × P per sq. metre foot-path and not more than 200 kg per m ² . | (ii) Spans upto 0–25 ft 85 lb per sq. ft. Spans from 26 ft to 100 ft—60 lb per sq. ft. Over 100 ft spans— $P = \left(30 + \frac{3000}{L} \right) \left(\frac{(55-W)}{50} \right)$ $P = L.L. \text{ per sq. ft.}$ (maximum 60 lb per sq. ft.) |
| (iii) No allowance | (iii) Control for a "run-way" wheel of 6.5t (without impact) placed with its contact area close to railing. 50 per cent overstressing permitted. | L=loaded length of side-walk in ft W=width of side-walk. (iii) Concentrated wheel load of 15600 lb applied one foot from the face of rail. Stress $f_s = 30000 \text{ p.s.i.}$ $f_c = 1670 \text{ p.s.i.}$ $N = 10$ |

| RHODESIA | SWEDEN | SWITZERLAND | TURKEY |
|---|--|---|---|
| See clause 1.4 B.S. 153/1954 Part 3 Calculations of forces on structures, page 16 et seq. Civil Engineering Code of Practice No. 2 (1951) "Earth Retaining Structures" issued by the Institution of Structural Engineers, London. | 1.5 t per m ² each lane of 3 m width. For more than 2 lanes, the surcharge may be reduced in the same proportion as the loading, i.e. for more than two lanes, only 50 per cent extra lanes is to be added. This surcharge may be considered uniformly distributed over the width of abutment. | 2 tonnes per m ² | 0.80 m extra height of earth fill. |
| Minimum width 2 ft 6 in. (i) 80 lb per sq. ft. (ii) Clause 4C, B.S. 153/1954 Part 3 Section A (iii) Accidental loading of a 4 Ton wheel is investigated at edge of parapet, allowing 25 per cent increase in permissible working stresses. | Minimum width—1.5 m. Separate footpath (i) 400 kg per m ² uniformly distributed when loaded length exceeds 10 m. The above mentioned load be reduced for main girders and arches to 1/6 pt. per m ² . P=uniform lane loading as per Fig. 15 in Plate IV. (iii) Single axle load of 14 t (without impact) placed near the railing. For dead load plus single axle load of 14 t the stressess allowed may not exceed lower yield point of steel and 1/2 cube strength of concrete respectively. | (i) Main roads.... 360 kg per m ² Secondary roads... 240 kg per m ² (ii) No | Minimum width— 0.75 m (i) 300 kg per m ² (for spans upto 30 m) (ii) $P = \left(0.3 + \frac{0.9}{L} \right) \left(5.5 - \frac{W}{3} \right)$ (t per m ²) for spans bigger than 30 m L=span length in m. W=footpath width in m (iii) Single wheel load of 6 tonnes (No over stressing) |

| QUESTIONS | AMERICA (U.S. Bureau of Public Roads) | AUSTRIA | CANADA |
|--|--|---|---|
| 11. Foot bridges. | Article 1.2.11* | | TORONTO |
| (i) The minimum width of foot bridge acceptable. | (i) No such minimum widths specified. | (i) No standard dimensions. | (i) Variable |
| (ii) The loading specified in the design of the deck in | (ii) No distinction made. | (ii) Austrian standards assume no different loads for rural and urban areas. | (ii) Urban areas } 100 lb per sq. ft. Rural areas } |
| (a) Urban areas | | Bridge class I—uniform load of 0.5 per t m ² | |
| (b) Rural areas | | Bridge class II—uniform load of 0.4 t per m ² | |
| (iii) Loading stipulated for the design of hand-rails. | (iii) See Fig. 5 in Plate I. | (iii) 0.08 t per m on the upper edge of the hand-rail in horizontal and vertical direction. | (iii) No definite specification |
| | | | ONTARIO |
| | | | (i) As required (ii) Article 1.2.11* (iii) 1.2.11 revised interim (1964) |
| 12. Any formulae stipulated for calculating the impact on piers and abutments due to floating objects in the river | Article 1.2.17* | | TORONTO |
| (i) floating timber | (i) No details given. | | (i) & (ii) None since Canada's climate dictates that ice is normally critical. |
| (ii) vessels and small river craft | (ii) No details given. | | |
| (iii) ice | (iii) No details for impact of ice are given. However ice pressure on piers to be taken at 400 lb per sq. in. The thickness and height of ice to be determined by site investigation. | | (iii) Dictated by site conditions (<i>i.e.</i> size of river, water velocity etc.) |
| | | | ONTARIO |
| | | | Article 1.2.17* |
| 13. Any other information supplied. | Clearance. For structures over Interstate Highway System—16 ft clear over the entire width of roadway including shoulders. | | |

*Articles referred to relate to the A.A.S.H.O. Standard Specifications for Highway Bridges (1961).

| FINLAND | FEDERAL REPUBLIC OF GERMANY | GREAT BRITAIN |
|---|-------------------------------|--|
| (i) 4·0 m | (i) — | (i) 6 ft |
| (ii) | (ii) No special specification | (ii) |
| (a) 400 kg per m ² or 7 ton axle | | (a) 100 lb per sq. ft. |
| (b) —do— | | (b) 80 lb per sq. ft. |
| (iii) Uniformly distributed load 80 kg per m concentrated load 100 kg (vertical or horizontal). | (iii) Horizontal-80 kg per m | (iii) Between 50 lb and 100 lb per linear foot according to situation. The force to be applied 3 ft above the footway. |
| | No specification. | Each case is considered on merits and no standard formulae are used. |
| (i) protection required | | |
| (ii) 1·0.....3·0 t per m | | |
| (iii) 10.....20 t per m solid | | |
| 10.....50 t per m floating | | |
| | | Minimum headroom provided (a) overall roads-16 ft 6 in. (b) In pedestrian subways-7 ft. (c) In cycle or combined cycle and pedestrian subways-7 ft 6 in. (d) In cattle creeps-8 ft For detailed information refer B.S. 153—Girder Bridges Part 3 loads-stresses, Section—A loads, and Ministry of Transport Memorandum No. 771. |

| QUESTIONS | INDIA | ITALY | JAPAN |
|--|--|---|---|
| 11. Foot bridges. | | | |
| (i) The minimum width of foot bridge acceptable. | Clause 116* | No details given. | (i) 1·5 m |
| (ii) The loading specified in the design of the deck in | Shall be designed to resist a lateral horizontal force and a vertical force, each of 100 lb per linear foot applied simultaneously at the top. | | (ii) For urban and rural areas. |
| (a) Urban areas | | | (a) 500 kg per m ² for deck |
| (b) Rural areas | | | (b) 350 kg per m ² for main girder |
| (iii) Loading stipulated for the design of hand-rails. | | Parapets must not be less than one metre high and should be loaded with a horizontal force of 250 kg per m run applied along the hand-rail. | (iii) 250 kg per m |
| 12. Any formulae stipulated for calculating the impact on piers and abutments due to floating objects in the river | No details given. | No details given. | |
| (i) floating timber | | | (i) |
| (ii) vessels and small river craft | | | (ii) |
| (iii) ice | | | (iii) |
| | | | |
| (iv) Car—[100 t in car direction, 50 t in other directions at height of 1·2 m] | | | |
| 13. Any other information supplied. | | | |

*Articles referred to relat

*Clause referred to relates to the Indian Roads Congress Standard Specifications and Code of Practice for Road Bridges-Sections I & II (1964).

| MALAYSIA | NEW SOUTH WALES | NEW ZEALAND |
|----------------------------------|--|--|
| (i) 6 ft | Clause 2.12* (i) not given | (i) Minimum width between rails to be 6 ft. |
| (ii) | (ii) same as Q. 10(i) & (ii) | (ii) |
| (a) 100 lb per ft | | (a) Live load 100 lb per sq. ft. |
| (b) —do— | | (b) Live load 60 lb per sq. ft. (except over motorways) |
| (iii) 25-100 lb per linear ft | (iii) Top members of railings Lateral horizontal force of 150 lb per linear ft and simultaneous vertical force of 100 lb per linear foot applied at top of railing. Lower railing: Lateral horizontal level force for 150 lb per linear ft. | (iii) Lateral load of 60 lb per linear ft applied at top rail level. |
| Clause 15, B.S. 153—Part 3A:1954 | | |
| Nil | Clause 2.17* | Not taken into account. |
| | (i) Force to be calculated on the assumptions that the log weighs 2 Tons and travels at normal stream velocity. The log shall be stopped in a distance of 1 foot for timber piers, 6 in. for column type piers and 3 in. for solid type concrete piers. Should fender piles or timber sheathing be placed upstream from the pier to absorb the energy of the blow, distances may be increased. (ii) No details given. (iii) —do— | |

*Clauses referred to relate to Highway Bridge Design Specifications of N.A. of A.S. Road Authorities (1965).

NORWAY

So far no specifications adopted.

PHILIPPINES

(i) 5 ft (clear roadway)

(ii)

(a) 100 lb per sq. ft.

(b) —do—

(iii) 150 lb per sq. ft. horizontal force with simultaneous vertical force of 150 lb per sq. ft. applied at the top of railing.

RHODESIA

(i) 2 ft 6 in.
8 ft, if combined with cycle track bridge.

(ii) Section 4 C, B.S. 153/1954 Part 3 Section A

(a) 50 lb per sq. ft.

(b) —do—

(iii) 500 lb horizontal force at 2 ft 6 in. above surface level.

So far no specifications adopted.

Velocity of flowing water only considered.

$P = KV^2$ where

V = Velocity of water in ft per sec.

K = a constant which is $1\frac{1}{3}$ for square ends, $1/2$ for angle end where the angle is 30 degrees or less and $2/3$ for circular pier.

P = pressure in lb per sq. ft.

(i) No particular formulae adopted. Each structure treated according to the vegetation types predominant in its catchment area, e.g. heavy large trees, excessive bush, etc.

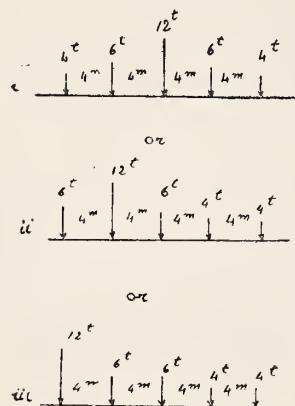
(ii) N/A

(iii) N/A

| SWEDEN | SWITZERLAND | TURKEY |
|---|--|--|
| <p>(i) 2.5 m</p> <p>(ii) 400 kg per m^2. In special case, the load may be reduced to 250 kg per m^2.</p> <p>(iii) Transverse live load of 100 kg per m applied at the top of railing.</p> | <p>(i) Not prescribed.</p> <p>(ii) 360 kg per m^2 and one over load of one t.</p> <p>(iii) 120 kg per m in towns 80 kg per m outside the towns.</p> | <p>(i) 2.5 m</p> <p>(ii)</p> <p>(a) 400 kg per m^2</p> <p>(b) 250 kg per m^2</p> <p>(iii) 100 kg per m</p> |
| <p>(i) Nil</p> <p>(ii) Nil</p> <p>(iii) Between 10 and 20 t per m of abutment or pier in question. In flowing water with ice, block pressure parallel to the stream may be assumed between 0.5 to 1.5 t per m of span length and 1/5th thereof perpendicular to the stream.</p> | <p>Not prescribed</p> | <p>(i) ——</p> <p>(ii) ——</p> <p>(iii) 30 kg per cm^2 multiplied by the area consisting of the width of the pier and the thickness of ice.</p> |
| <p>Vertical clearance</p> <p>(i) Roadway 4.6 m</p> <p>(ii) Cycle track 2.5 m</p> <p>(iii) Foot-path 2.2 m</p> | | |

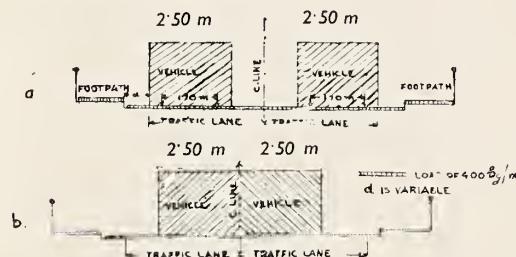
BELGIUM

1. Normal train loading



Over traffic lane 2.50 m² minimum wide to 4 m maximum wide and simultaneously a load of 400 kg per m² uniformly distributed on the carriageways and footpaths.

2. Lateral disposition of train loading



3. Number of train loadings

One train loading over traffic lane plus a load of 400 kg per m².

4. Effective wind pressure

The area of the train of vehicles assumed in elevation is a rectangular screen 2 m high with a length equal to the length of the train.

5. Impact factor

The impact factor due to live loads is the same for in question No. 1—i, ii, iii; and is given by the following formula :

$$\varphi = 1 + 0.377 \frac{v}{\sqrt{lx}} \sqrt{1 + \frac{2Q}{P}}$$

where

v =speed in kilometre per hour, always greater than 60

l =distance between supports, in metre

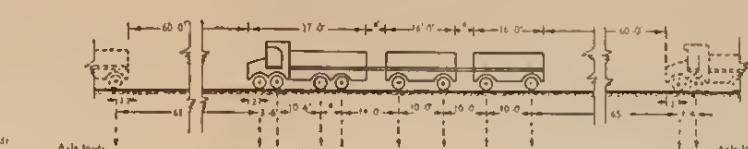
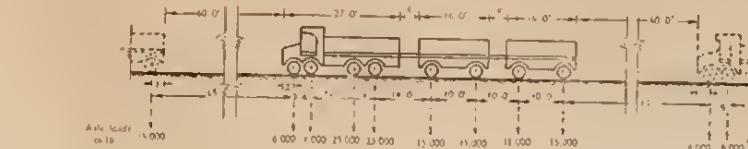
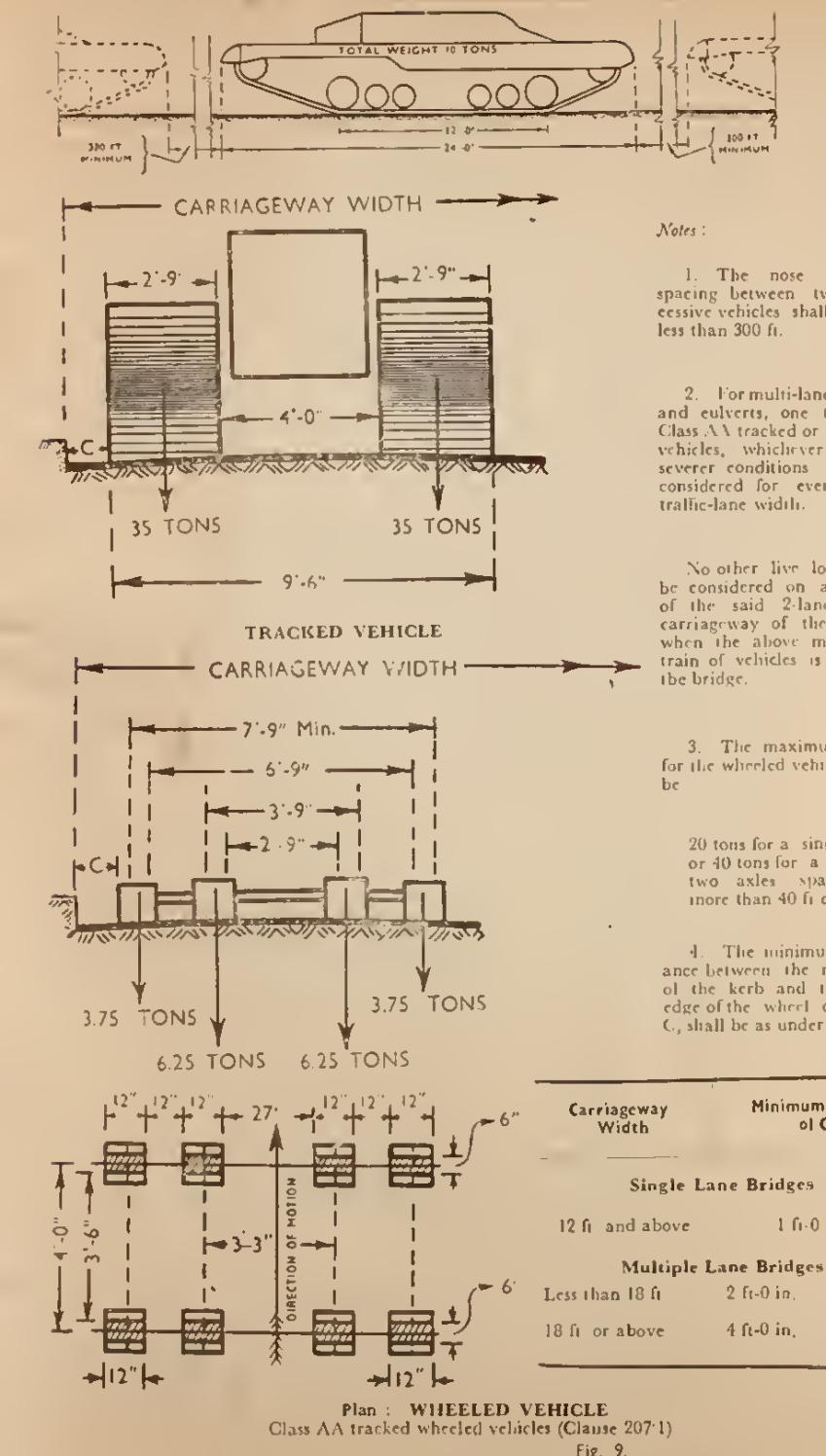
$$\alpha = \frac{l}{f_s}$$

f_s =static deflection, in metre, due to dead weight

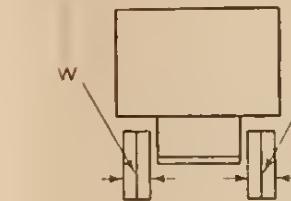
Q =moving loads on the bridge deck, in tonnes

P =deadweight of the bridge, in tonnes

INDIAN ROADS CONGRESS BRIDGE LOADINGS

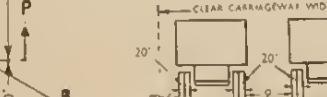


Class A train of vehicles



Notes:

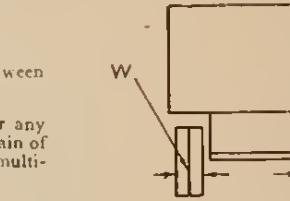
4. The minimum clearance, f_1 , between the outer edge of the wheel and the roadway face of the kerb, and the minimum clearance, g , between the outer edges of passing or crossing vehicles on multi-lane bridges shall be as given below :



| Clear carriageway width | g | f_1 |
|-------------------------|--|----------------------------------|
| 18 ft to 24 ft | Uniformly increasing from 1 ft 4 in. to 4 ft | 4 ft |
| Above 24 ft | 4 ft | 6 in. for all carriageway widths |

Fig. 10.

Class B Train of Vehicles



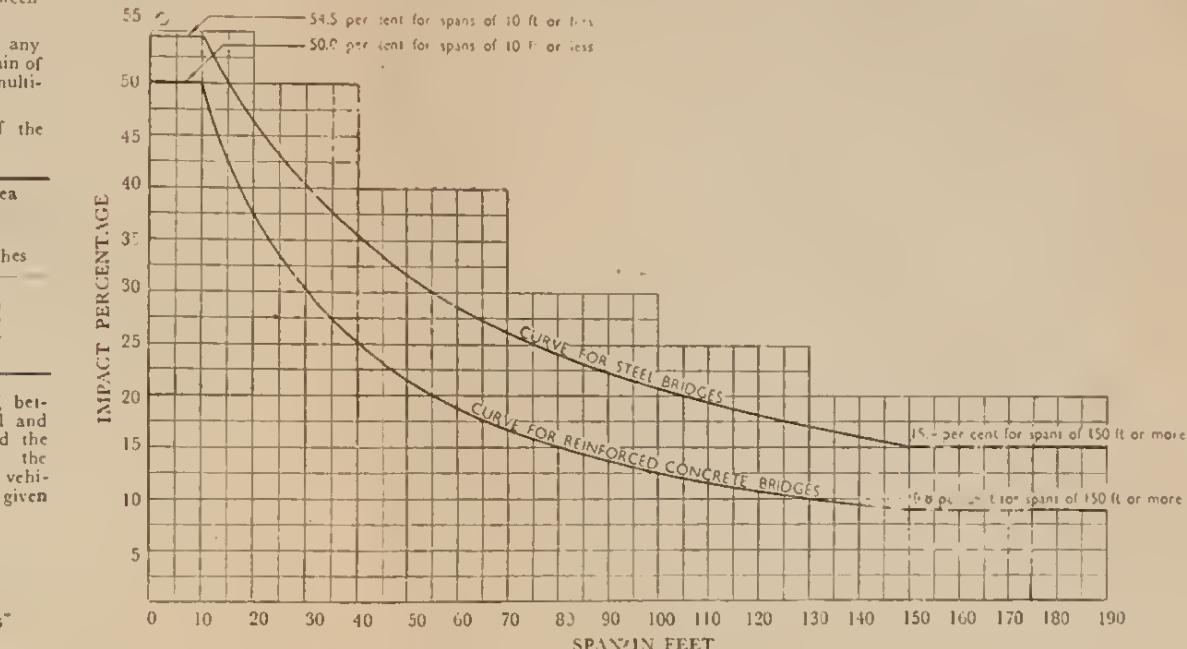
Notes:

4. The minimum clearance, f_1 , between the outer edge of the wheel and the roadway face of the kerb, and the minimum clearance, g , between the outer edges of passing or crossing vehicles on multi-lane bridges shall be as given below :



| Clear carriageway width | g | f_1 |
|-------------------------|--|----------------------------------|
| 18 ft to 24 ft | Uniformly increasing from 1 ft 4 in. to 4 ft | 4 ft |
| Above 24 ft | 4 ft | 6 in. for all carriageway widths |

Fig. 11.



Impact percentage Curves for Highway Bridges for class A and class B loadings.

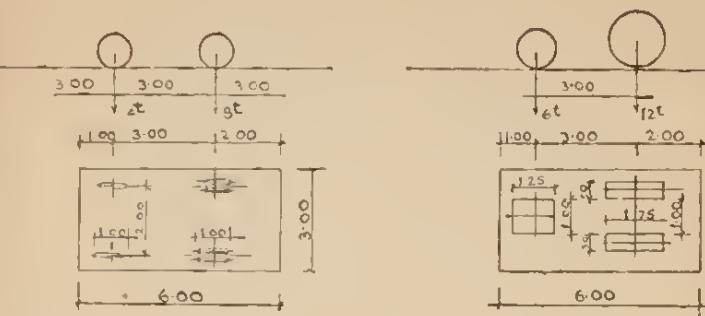
(Clause 211.2)

Fig. 12.

PLATE IV

ITALY
CIVIL LOADING

Type 1
CONTINUOUS TRAIN OF 12t TRUCK
Type 2
SINGLE 18t STEAM ROLLER

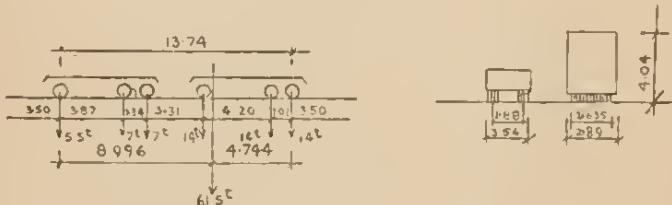


Type 3

CROWD LOAD OF 400 Kg./sq. m²

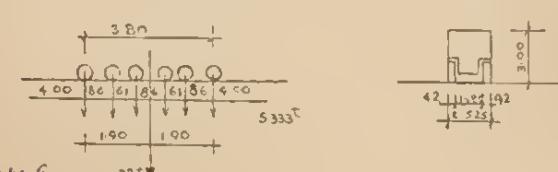
Type 4

CONTINUOUS TRAIN OF MILITARY LOAD OF 6.5 t



Type 5

CONTINUOUS TRAIN OF MILITARY LOAD OF 32t



Type 6

SINGLE MILITARY LOAD OF 74.5t

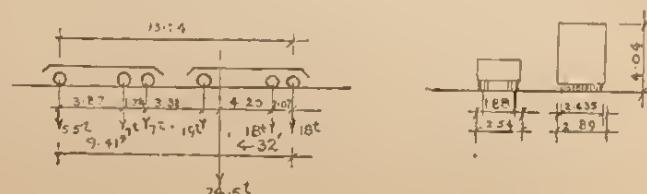


Fig. 13

Fig. 14.

SWEDEN

TRAFFIC LOADING FOR BRIDGES

Cl. Lane Loading

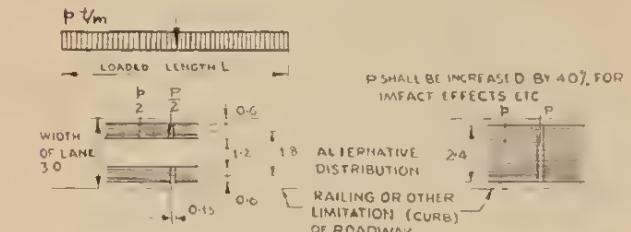
1. One = 14t Axle-Load Plus Distributed Load P t/m.

P=14t

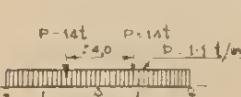
L<10 p=2.4

L=10-90 p=2.4 - $\frac{13(L-10)}{L}$

L>90 p=1.1

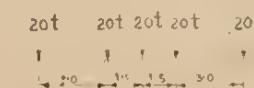


2. TWO 14t AXLE-LOADS PLUS DISTRIBUTED LOAD P t/m

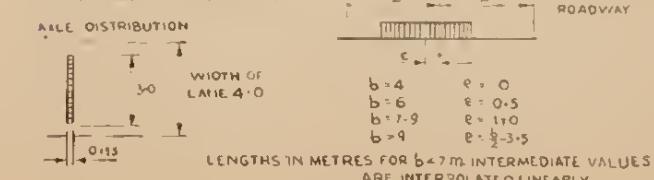
CONTINUOUS STRUCTURE WITH LOADED LENGTH $(L_1+L_2) \leq 50$ m

P SHALL BE INCREASED BY 40% FOR IMPACT EFFECT ETC

b. SINGLE-TRUCK LOADING

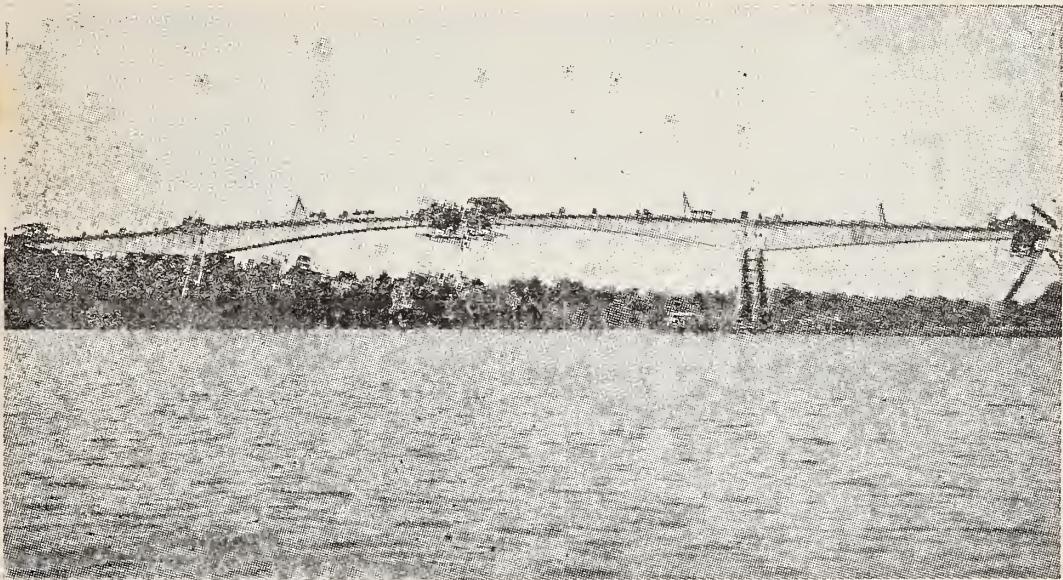


LATERAL DISPLACEMENT OF THE SINGLE TRUCK LOADING



LENGTHS IN METRES FOR b > 7.0. INTERMEDIATE VALUES ARE INTERPOLATED LINEARLY

Fig. 15.



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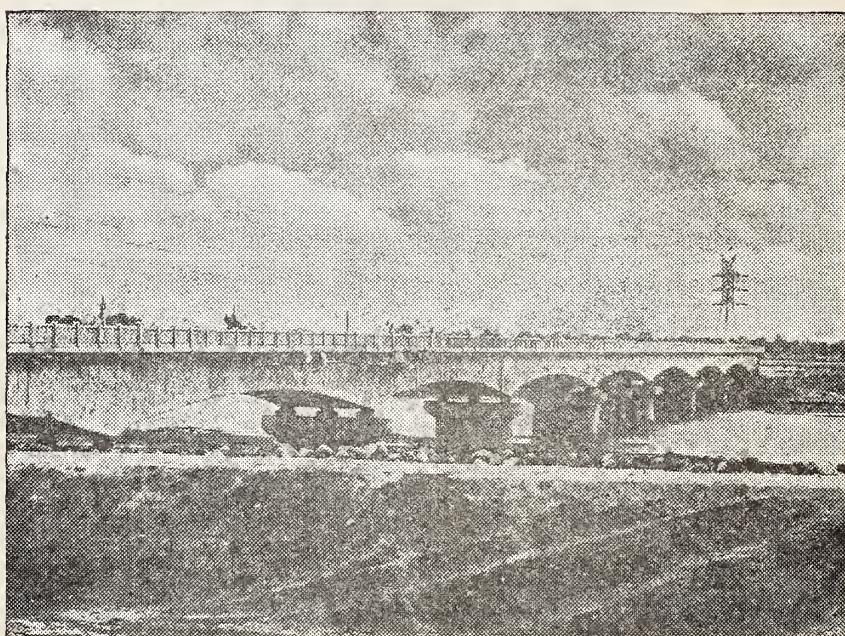
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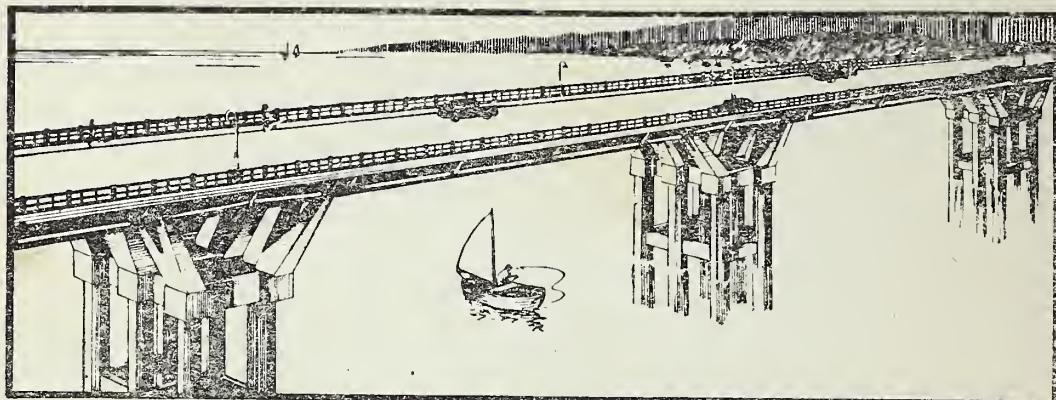
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